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### (54) Battery pack.

(57) A battery pack (12) can be carried by a person and has a connector (44) to which a power cord (86) of a tool or appliance may be detachably connected.

power cord (86). The self-retractable feature helps keep the power cord (86) away from the operating portion of a power tool (80').

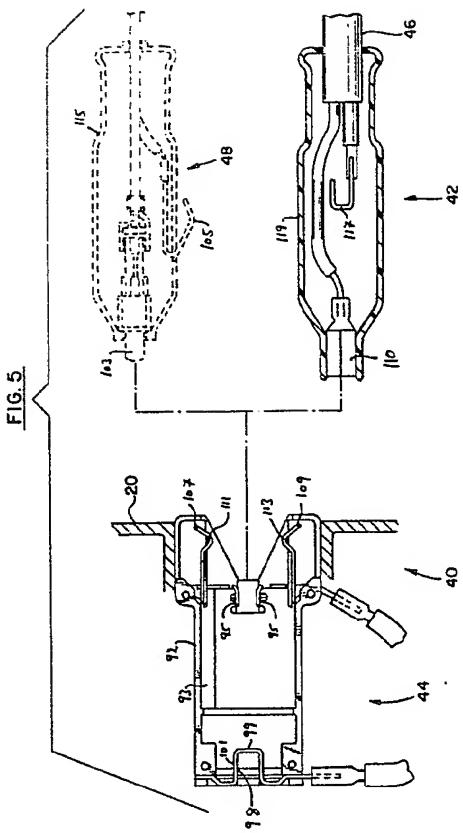
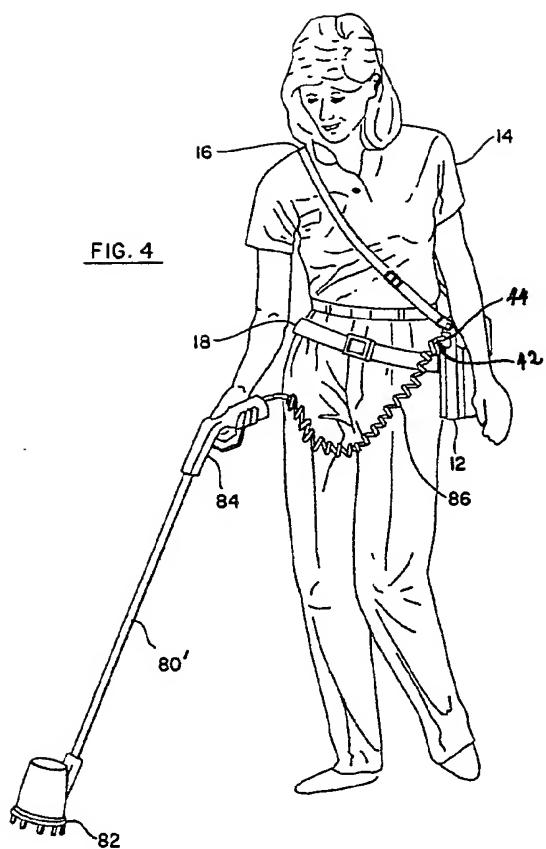
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The battery pack (12) has a socket (44) which can accept conventional (low current) cigar lighter socket-compatible plugs (48) and a new (high current) plug (42).

Means (90), (102) are provided to prevent a conventional cigar lighter plug (96) being actuated if it is inserted in the socket (44).

The plug (42) is provided with means (120) which prevent it being actuated if it is inserted in a conventional cigar lighter socket.

A power tool (80') or appliance can be connected to the power pack (12) by a self-retractable



BATTERY PACK

This invention relates to a battery pack for portable tools and appliances.

In recent years, low-voltage, direct current, for example, 12 VDC hand-held appliances and tools have proliferated for use in the car and around the home. Some appliances, such as hand-held car vacuum cleaners and car polishers, are intended for operation using power supplied from the car battery. These appliances, which are relatively low current devices, for example, 2-6 amps, typically employ a plug connector compatible with the socket of a conventional, dash-mounted automotive cigar lighter. The necessity for use of these appliances in close proximity to a vehicle having a cigar lighter socket has restricted the utilization of the same appliances around the home.

Many low voltage, hand-held tools used around the home require relatively high current levels, for example, 8-20 amps. These high current tools include hedge trimmers and grass trimmers. Conventionally, such tools are powered by rechargeable batteries contained within the tool.

In order to provide the tool with an acceptable operating time it is necessary to use several rechargeable batteries. However, these add to the weight of the tool and make it cumbersome to use.

With a view to reducing this problem the present invention provides a battery pack which can be carried by a person and which has a connector to which a power cord of a tool or appliance may be detachably connected.

Preferably, said connector comprises a socket which, advantageously, can accommodate both a conventional cigar lighter socket-compatible plug and a plug which is capable of carrying higher currents. A suitable socket is disclosed in our co-pending European Patent Application No. 87 000 000 000 of even date.

Preferably, the socket is provided with means to inhibit actuation of a conventional cigar lighter on insertion in the socket. Such means may comprise, for example, a boss to engage the face of the cigar lighter and prevent its coming into contact with an electrode in the socket.

The battery pack may contain a plurality of rechargeable NiCd cells. However, it preferably contains a lead-acid type battery.

The battery pack may also contain or, more preferably, be associated with, recharging equipment, for example, a transformer, a rectifying circuit and, optionally, a voltage control circuit.

Conventionally, battery powered tools and appliances are cordless. In contrast tools or appliances for use with battery packs in accordance with the present invention will have a cord. By

making such a cord self-retractable then the tool or appliance can be freely manipulated by the user without undue hindrance from the cord. A normally coiled cord is quite suitable for this purpose and, accordingly, the present invention provides a battery pack in accordance with the invention in combination with a tool or appliance which is connected to said battery pack by a self-retractable cord.

When the battery pack is provided with a socket the self-retractable cord may be provided with a plug which can be inserted in the socket but which is provided with means for preventing actuation on insertion of the plug in a conventional cigar lighter socket.

For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 is a schematic representation showing a battery pack in accordance with the invention, various portable tools and appliances connected to the battery pack and the battery pack being recharged;

Figs. 2 and 3 are perspective and side views respectively of the battery pack;

Fig. 4 is an illustration of the battery pack shown in Figs. 2 and 3 being worn by a user and connected to a high current power tool;

Fig. 5 is a schematic cross-section of a socket forming part of the battery pack together with a conventional cigar lighter-compatible plug (shown in chain lines) and a plug for carrying higher currents;

Figs. 6 and 7 are schematic top and end views showing the battery pack in a recharging base;

Fig. 8 is a circuit diagram of the components in the recharging base;

Fig. 9 is a circuit diagram of the components in the battery pack;

Figs. 10 and 11 show two different types of cigar lighter being inserted in the socket; and

Fig. 12 shows a cigar lighter socket with a cigar lighter in chain lines and the plug for carrying higher currents shown in Figure 5 inserted in the cigar lighter socket (in chain lines).

Referring to Figure 1 there is shown a battery pack which is generally identified by reference numeral 12. As shown, the battery pack 12 can be connected to various low current tools and appliances, for example, a car vacuum, a car polisher, and a low power drill. These tools and appliances typically operate at 12 VDC with a current of 2-6 amps.

The battery pack 12 can also be connected to

various high current tools and appliances, for example, a hedge trimmer and a grass trimmer. These tools typically operate at 12 VDC with a current of 8-20 amps.

As shown in Figure 4, the battery pack 12 can be carried by an operator 14 by a combination of shoulder strap 16 and waist strap 18.

As best seen in Figures 2 and 3, battery pack 12 comprises a housing 20 which is formed from an impact resistant plastic in a two-piece "clamshell" construction. Housing 20 includes an integrally formed hand grip portion 22 and a side 24 which is inwardly curved to conform to the rounded trunk of the operator 14. Housing 20 also includes stud members 26, 28 for attaching shoulder strap 16 and loop members 30, 32 for receiving waist strap 18.

While battery pack 12 may be supported by operator 14 through either shoulder strap 16 or waist strap 18 alone, a more comfortable and secure attachment is provided through the use of both shoulder strap 16 and waist strap 18 simultaneously as shown in Figure 4.

With continued reference to Figure 3, battery pack 12 contains a plurality of rechargeable batteries, such as batteries 34 and 36. It is preferred that batteries 34, 36 be of the lead-acid type which exhibit superior voltage/current performance characteristics over extended temperature ranges. This extended operating range is intended to further increase the utility of the overall system.

A socket 44 is mounted on the housing 20. The socket 44 has a cylindrical housing 92 which contains a cylindrical metal casing 93. One pair of ears projects generally radially outwardly from diametrically opposite sides of the cylindrical metal casing 93. The pair of ears 95a, 95b can be clearly seen in Figure 5. The socket 44 is also provided with a contact 98 which has an abutment surface 99 and a cylindrical outer surface 101.

As shown, in Figure 5, a conventional cigar lighter socket-compatible plug 48 comprises a spring loaded contact 103 and a spring wire contact 105. When the conventional cigar lighter socket-compatible plug 48 is inserted in the socket 44 the spring loaded contact 103 makes abutting contact with the abutment surface 99 and the spring wire contact 105 makes abutting contact with the cylindrical metal casing 93. The plug 48 is retained in the socket 44 by two resilient arms 107, 109 which have inwardly projecting portions 111, 113 respectively which engage sloping surface 115 of plug 48.

Whilst this arrangement is quite adequate for handling low currents, for example, 2-6 amps, it is not suitable for handling high currents, for example, 8-20 amps.

Plug 42 is capable of handling higher currents

and includes a first wiping member in the form of a cylindrical sleeve 110 of brass and a second wiping member in the form of U-shape member 117 which has portions which project radially outwardly from diametrically opposite sides of the resilient plastic casing 119 of the plug 42. When the plug 42 is inserted in the socket 44 the cylindrical sleeve 110, which is an interference fit with the cylindrical outer surface 101 of the contact 98, rubs along the cylindrical outer surface 101 thereby wiping away at least some of any oxide or dirt layer present and making a good electrical contact between a substantial portion of the surface area of the inside of the cylindrical sleeve 110 and the cylindrical outer surface 101 of the contact 98.

Similarly, the portions of the U-shape member 117 which project to either side of the resilient plastic casing 119 of the plug 42 rub along the ears thereby cleaning at least part of the surface of the ears and making good electrical contact over a substantial portion of the contact area. The forward end of the resilient plastic casing 119 projects beyond the forward extremity of the cylindrical sleeve 110 thereby preventing the cylindrical sleeve 110 coming into contact with the end electrode of a conventional cigar lighter socket as described hereinafter. Further details of the plug 42, socket 44 and cigar lighter socket-compatible plug 48 can be found in our co-pending European Patent Application No. 87 0 000000 of even date.

Because of the intended compatibility with conventional low-current cigar lighter socket-compatible plugs, the socket 44 has means for preventing insertion of a conventional cigar lighter plug.

As shown schematically in Figs. 10 and 11, socket 44 includes a boss 90 integrally formed with cylindrical housing 92. Boss 90 is sized to intercept axial face 94 of cigar lighter plug 96 (shown in broken lines) and space axial face 94 from contact 98 to prevent an electrical connection. Also, housing extension 100 includes a lip portion 102 sized to intercept flange 104 of cigar lighter plug 96' (see Fig. 11). The heat generated by activation of cigar lighter plug 96 could damage the cylindrical housing 92 which, as stated previously, is made of a resilient plastics material.

It is undesirable that plug 42 should be actuated on insertion in a conventional cigar lighter socket such as cigar lighter socket 118 in Figure 12. This is because the cigar lighter socket 118 might be fused at, for example, 6 amps, whilst the appliance connected to the plug 42 could require a higher current, for example, 16 amps. As shown in Fig. 12, a part 120 of plug 42 projects beyond cylindrical sleeve 110 thereby preventing electrical contact between cylindrical sleeve 110 and contact face 116 of cigar lighter socket 118 (shown in broken lines).

The battery pack 12 can be recharged in a charging unit designated generally by the numeral 50 (Figures 6 and 7). The charging unit 50 comprises a housing 52 which serves as a stand for receiving battery pack 12 during charging operations. Housing 52 can be optionally rested on a horizontal surface such as surface 54 as depicted in Figure 7 or can be mounted on a vertical surface such as surface 56 as depicted in Figure 6.

As shown in Figure 8, the housing 52 contains a transformer 60 the input of which is shown operationally connected to a source 62 of standard house AC power. The output of the transformer 60 is connected to a full wave rectifier 68' the output of which is smoothed and stabilised by a voltage regulator 66. The output of voltage regulator 66 is delivered to prongs 70 and 72.

When battery pack 12 is mounted on charging unit 50 prongs 70, 72 come into contact with contacts 74, 76 in battery pack 12. As shown in Figure 9, contacts 74, 76 are electrically connected across the batteries of battery pack 12. LED 78, shown schematically in Figure 9 with associated resistor 79, is disposed on the outside of housing 20 (see Figure 7) and provides a visual indication of power flow to batteries 34, 36 during charging. The LED 78 is rated at 50 millamps and the resistor 79 at 660 ohms, 0.5 watts, 10%. Battery pack 12 also includes a circuit breaker 80 connected in series between batteries 34, 36 and socket 44 to provide protection against excessively high current flow in the battery circuit. Circuit breaker 80 is rated at 20 amps.

With reference to Fig. 3, circuit breaker 80 can be positioned conveniently in hand grip portion 22 of housing 20. Diode 81 in the Figure 9 circuit schematic is a type 4002, 50 volt PIV.

Each of the power tools and appliances intended for operation with the battery pack includes a power cord and a cord control means for biasing the power cord away from the ground and away from the operational end of the respective power tool or appliance. With reference to Figure 4, power tool 80' which is a weed trimmer having an operational end (trimming head) 82 and a handle 84 includes a power cord 86 which is spirally coiled to be self-retractable along its length. One end of the power cord 86 is permanently connected to the power tool 80 at handle 84 while a plug 42 is attached to the other end of power cord 86 and, in turn, is inserted into socket 44 in battery pack 12. The self-retractable power cord 86 prevents entanglement with the user's feet and arms while permitting a full range of motion of power tool 80'. The self-retractable power cord 86 also inhibits damage to the power cord 86 caused by inadvertent engagement with operational end 82 of power tool 80'.

## Claims

1. A battery pack characterized in that it can be carried by a person and has a connector (44) to which a power cord (86) of a tool or appliance may be detachably connected.
  2. A battery pack according to Claim 1, characterized in that said connector (44) comprises a socket (44).
  3. A battery pack according to Claim 2, characterized in that said socket (44) can accommodate a conventional cigar lighter socket-compatible plug (48) and a plug (42) which is capable of carrying higher currents.
  4. A battery pack according to Claim 2 or 3, characterized in that it includes means (90) to inhibit actuation of a conventional cigar lighter plug (96) on insertion therein.
  5. A battery pack according to any preceding Claim, characterized in that it includes one or more straps (16, 18) to enable said battery pack (12) to be strapped to the waist of a user and/or supported by his or her shoulder.
  6. A battery pack according to any preceding Claim, including one or more lead-acid type batteries (34, 36).
  7. A battery pack according to any preceding Claim, and a charging unit (50) therefor, said charging unit (50) comprising a transformer (60), a rectifier (68'), a voltage regulator (66) and means (70, 72) for engaging contacts (74, 76) in said battery pack (12) when mounted on said charging unit (50) for conveying electricity from said charging unit (50) to said battery pack (12).
  8. A battery pack as claimed in any preceding Claim and a tool or appliance electrically connected thereto by a self-retractable cord (86).
  9. A battery pack according to Claim 8 when appended directly or indirectly to Claim 2, characterized in that said self-retractable cord is provided with a plug (42) which can be inserted into said socket (44).
  10. A battery pack according to any preceding Claim, wherein said socket and/or said plug is of the type claimed in any Claim of our co-pending European Patent Application No. 87 000000 of even date.
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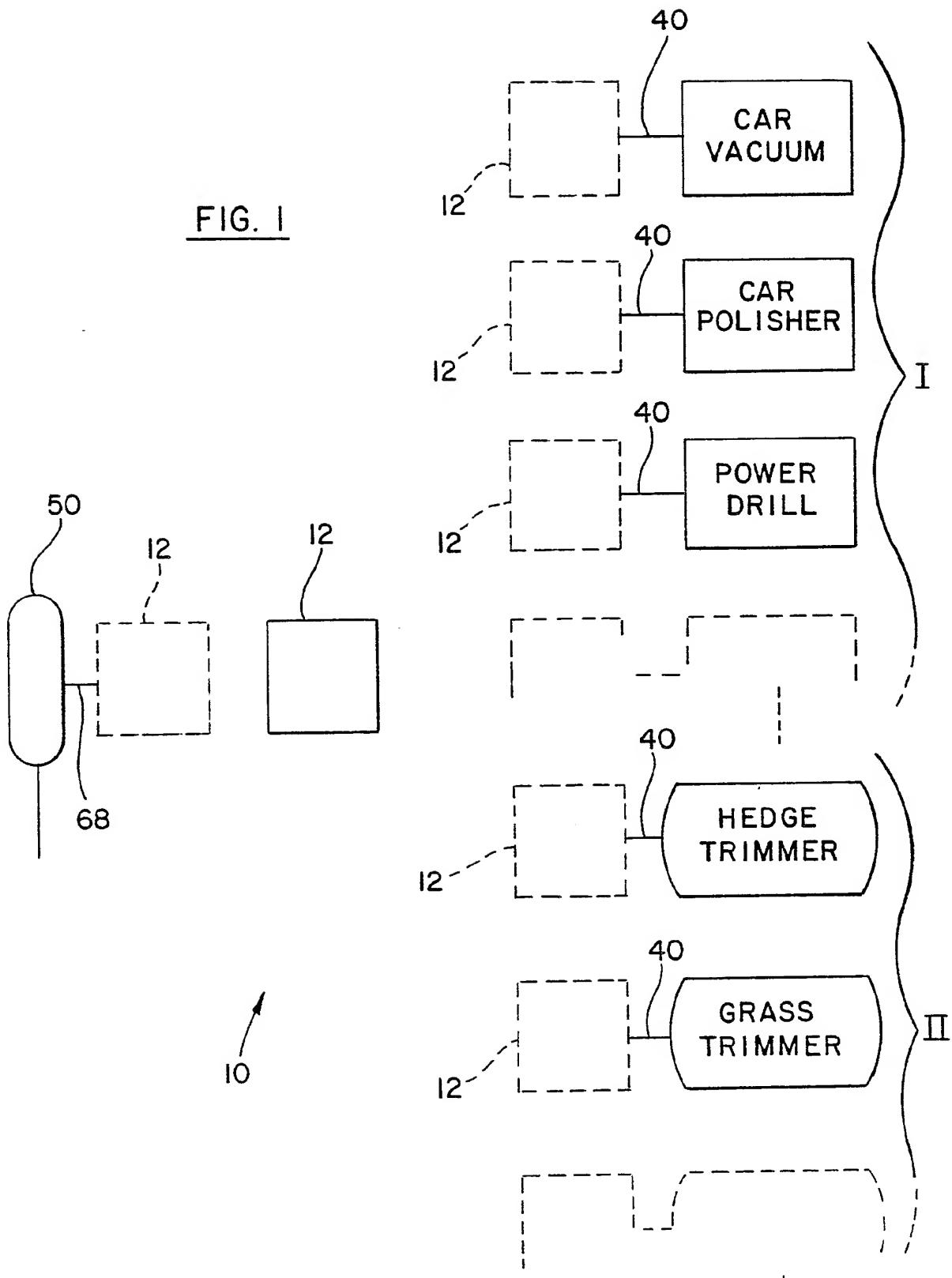
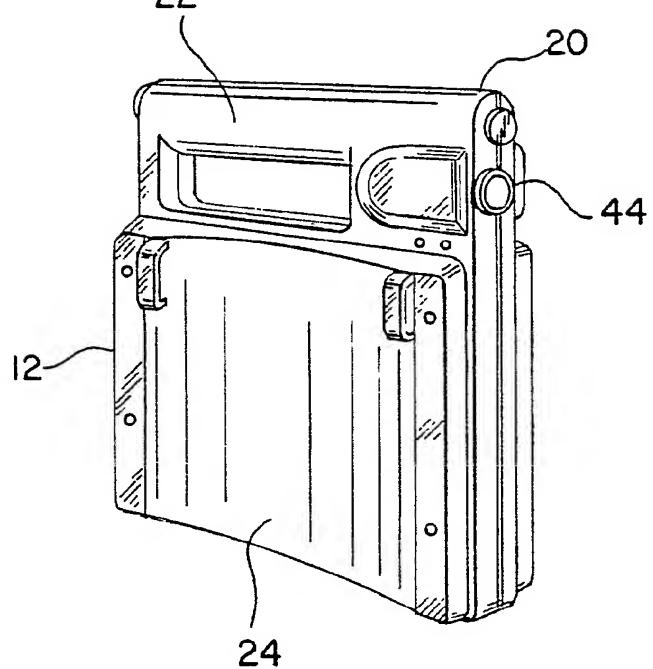
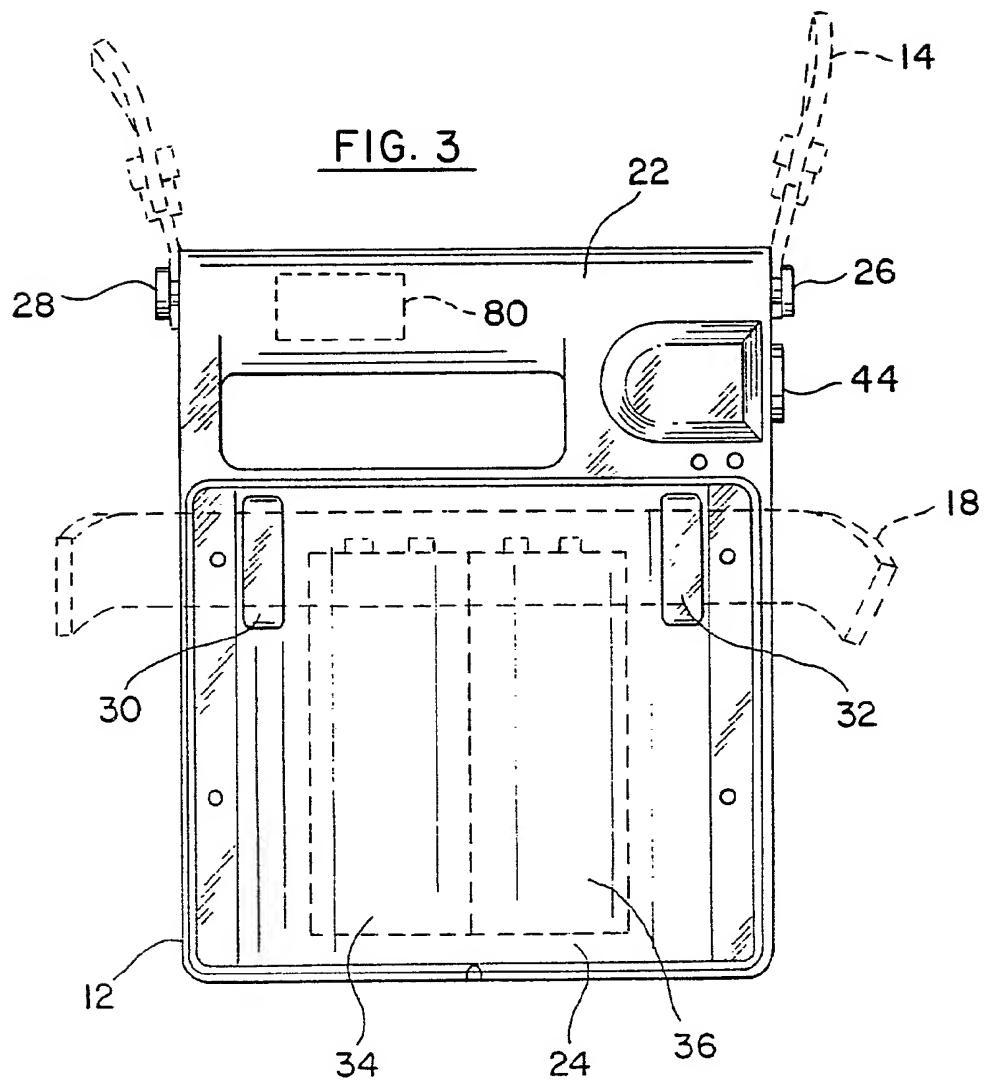
FIG. 1

FIG. 2FIG. 3

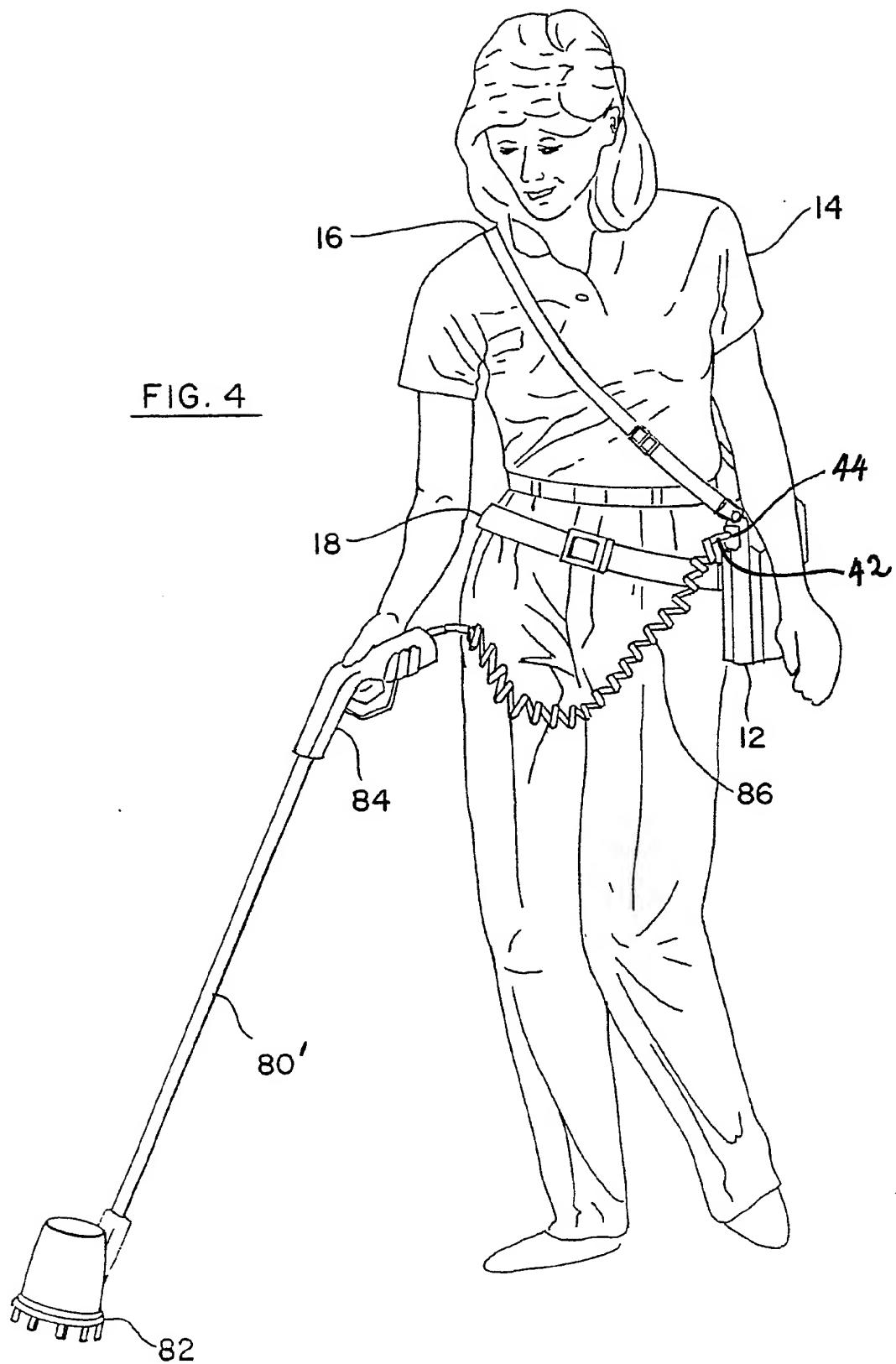
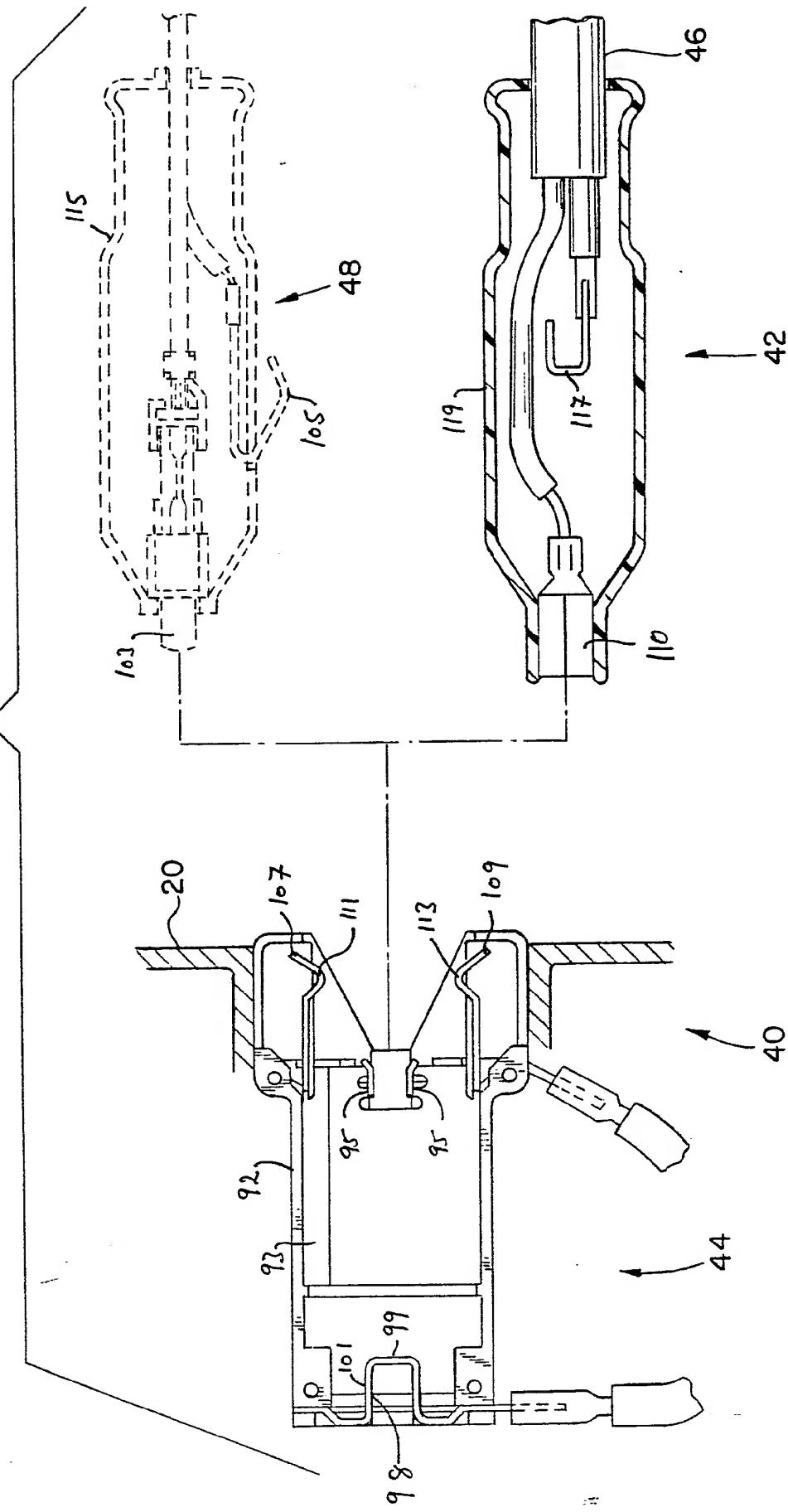


FIG. 5

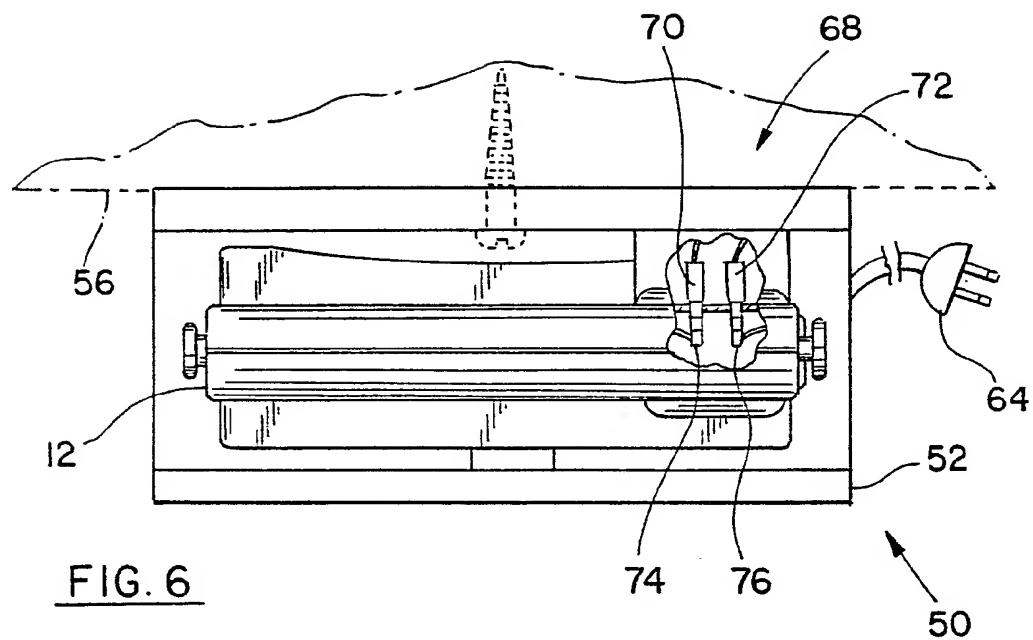
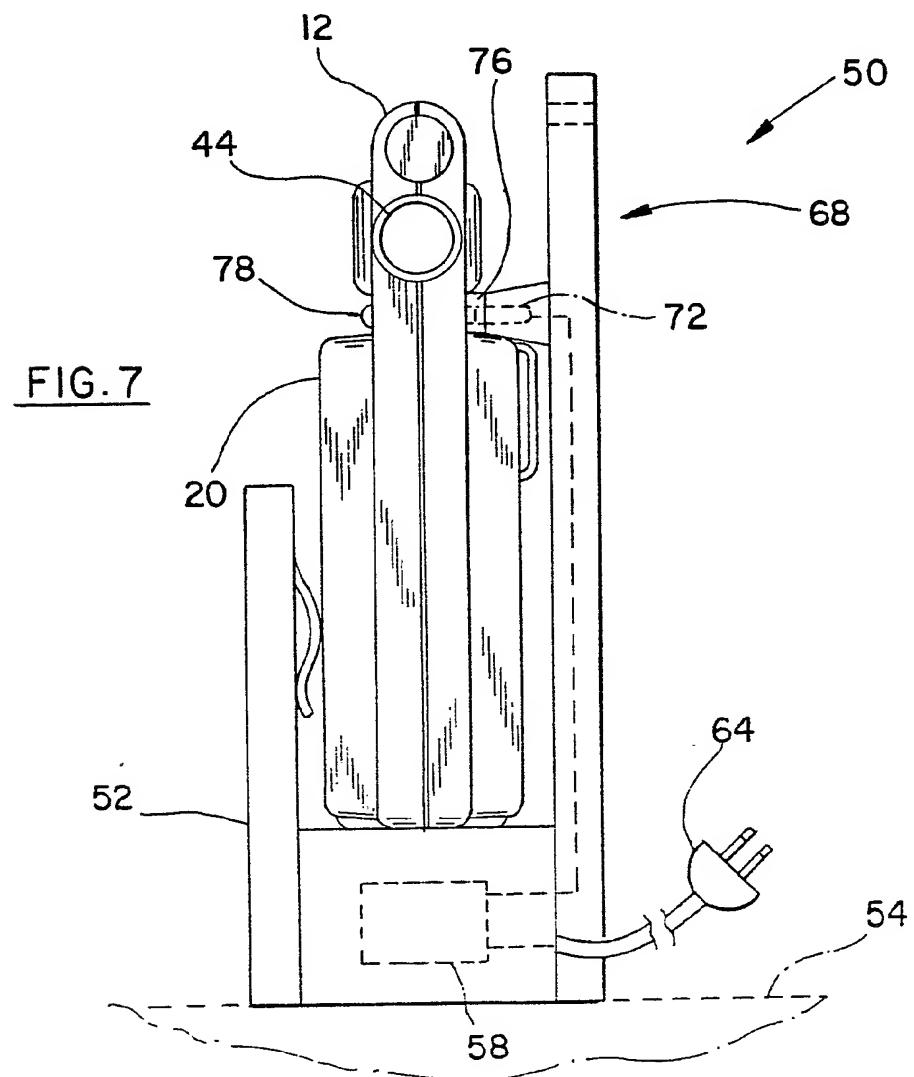
FIG. 6FIG. 7

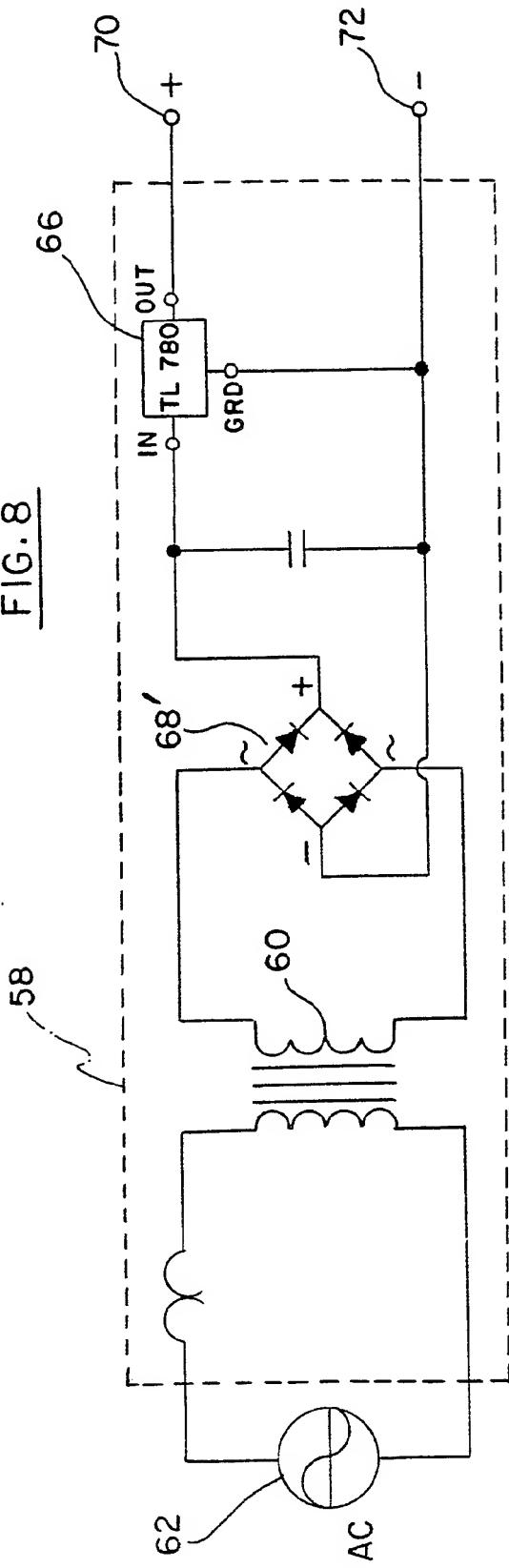
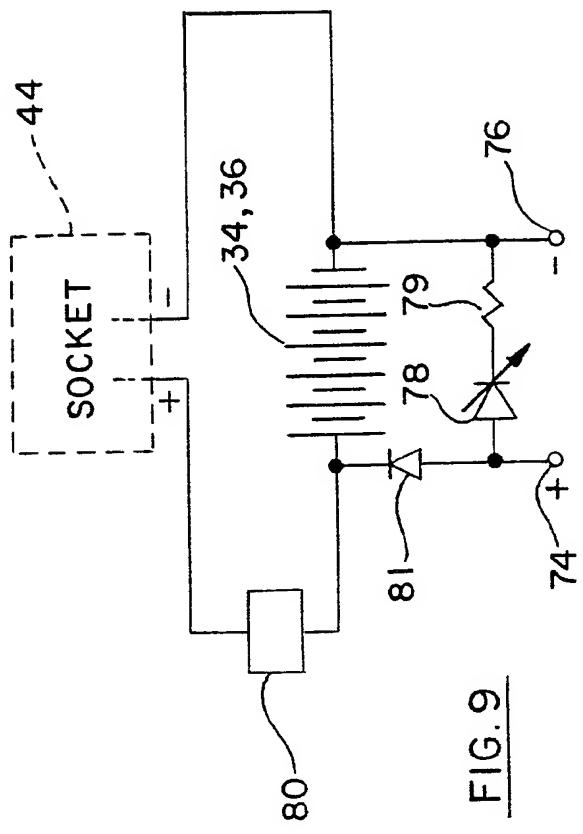
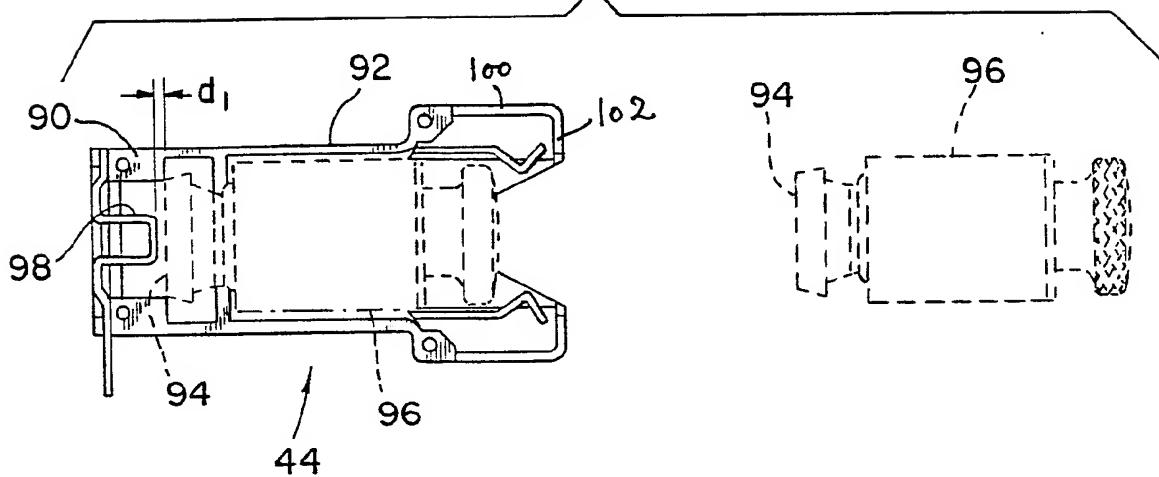
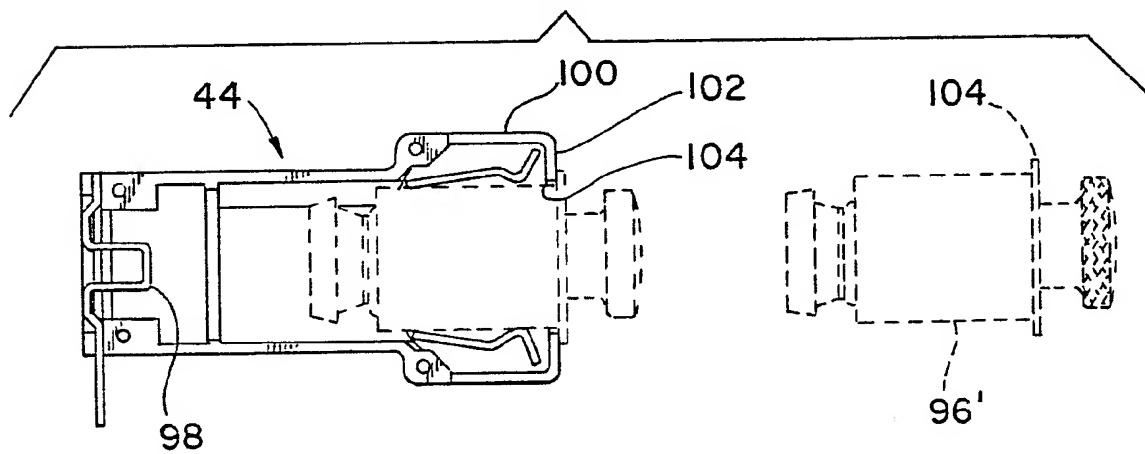
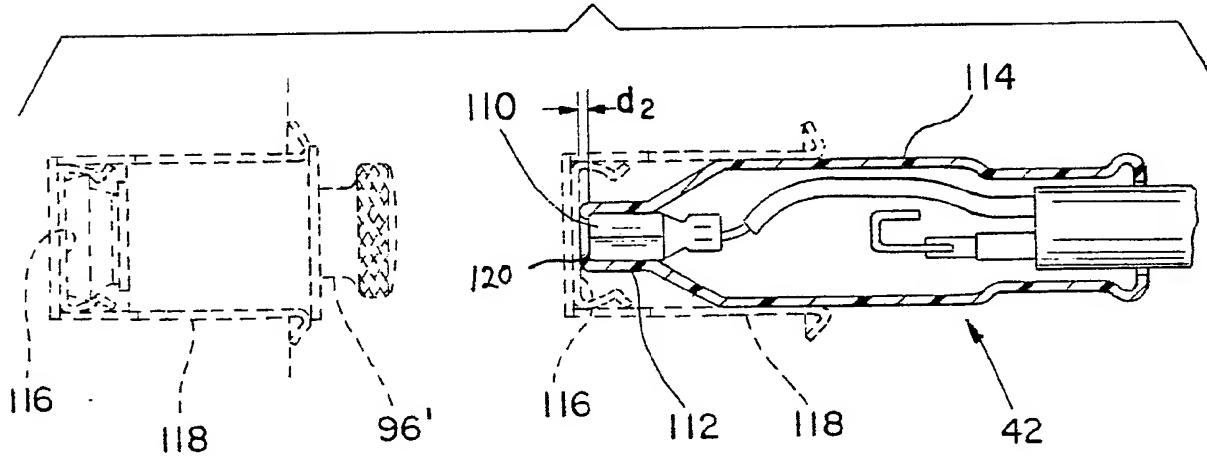
FIG. 8FIG. 9

FIG. 10FIG. 11FIG. 12



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# EUROPEAN SEARCH REPORT

Application Number

EP 87 30 8844

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-3 432 294 (J. BECH) * Claims 1,3,4; page 4, lines 3-15; page 5, lines 4-28; page 6, lines 1-8; figures 1,3,4a,7,7a *	1,2,5,8 ,9	H 01 M 2/10 H 01 M 10/46 H 01 M 2/20 H 02 J 7/00
Y	---	6,7	
X	DE-A-3 540 853 (J. BECH) * Claim 1; column 1, lines 22-35; figures 1,1a *	1,2,5,8 ,9	
Y	---	6,7	
X	US-A-3 919 615 (R. NIECKE) * Figures 1,3; column 1, lines 3-14; column 2, lines 28-38; column 3, lines 3-12,33-40; column 4, line 48 - column 5, line 20; column 6, lines 1-13; claim 1 *	1,2,5	
Y	---	6,7	
X	US-A-3 274 476 (P. WILDUM) * Claim 1; column 1, lines 7-31; column 2, line 72 - column 3, line 24; column 3, lines 41-49; figures 1,3 *	1,2,5	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Y	EP-A-0 203 847 (BLACK AND DECKER) * Figure 2; claims 12,13 *	7	H 01 M H 02 J B 23 B
Y	US-A-3 912 998 (V.C. HARRIS) * Figure 8; column 4, lines 4-22 *	7	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30-05-1988	D'HONDT J.W.

### CATEGORY OF CITED DOCUMENTS

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# EUROPEAN SEARCH REPORT

EP 87 30 8844

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
Y	US-A-3 963 972 (G.M. TODD) * Figures 2,3; claim 1; column 1, lines 41-44,52-64; column 2, lines 48-66; column 3, lines 8-21; column 3, lines 5-18,31-41 * ---	6	
Y	GB-A-2 028 022 (DIEHL GmbH) * Figure; page 1, lines 6-27,52-65 * ---	6	
Y	US-A-2 991 376 (E.T. SHERWOOD) * Figures 1,2; column 1, lines 12-21,37-41; column 2, lines 18-19 * ---	6	
X	US-A-3 710 306 (L.J. McCARTHY) * Figures 1,2; column 1, lines 51-58; column 2, lines 45-60; claim 1 * ---	1,2,5	
X	DE-A-2 555 601 (G. THOMA) * Figures 1,2; claims 1,5,11; page 3, lines 3-8; page 1, last paragraph - page 2, paragraph 1 *	1,2,5	
Y	---	6,7	
A	US-A-3 453 578 (C.H. FERNALD et al.) * Figure 3; claim 1 *	10	
A	GB-A-1 108 357 (OLDHAM & SON) * Figure 5; page 2, lines 112-127 *	6	
A	GB-A-1 075 857 (BURNDEPT LTD) * Figure 2; page 2, lines 6-13; claims 1,3 *	6	
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The present search report has been drawn up for all claims			

Place of search	Date of completion of the search	Examiner
THE HAGUE	30-05-1988	D'HONDT J.W.
<b>CATEGORY OF CITED DOCUMENTS</b>		
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